Oct. 2, 1962 E. A. TIMSON 3,056,593

APPARATUS FOR DRYING WEBS OF PAPER OR THE LIKE

Filed Feb. 16, 1959 2 Sheets-Sheet 1

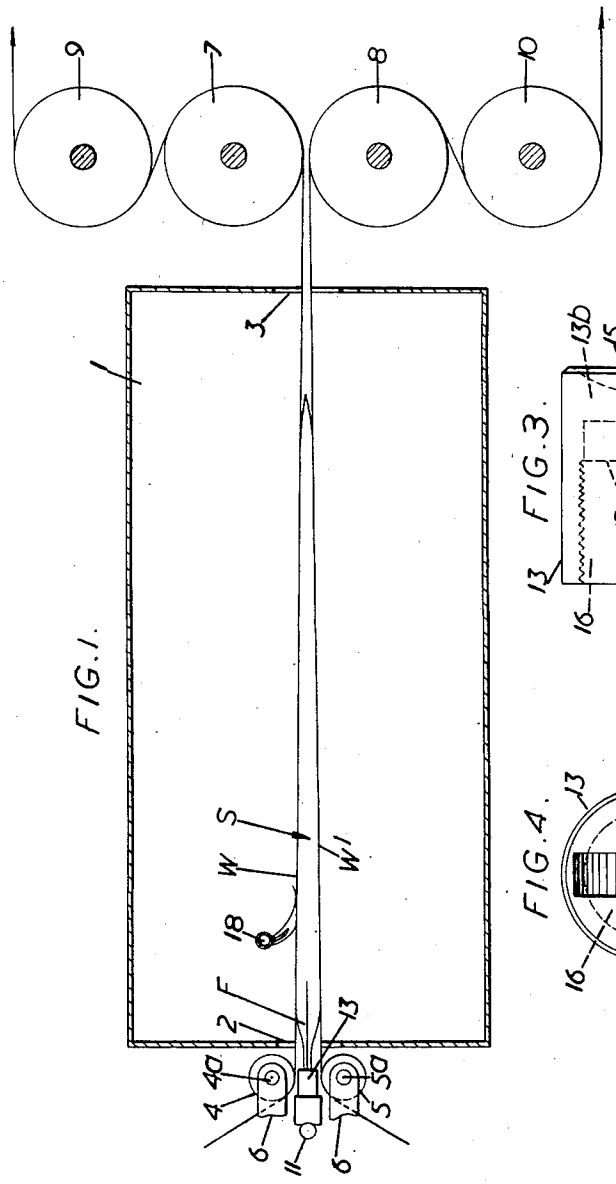


FIG. 1.

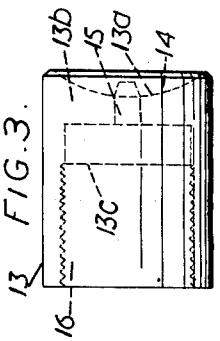


FIG. 3.

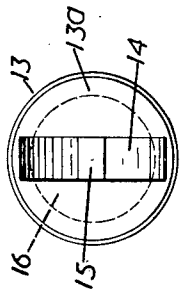


FIG. 4.

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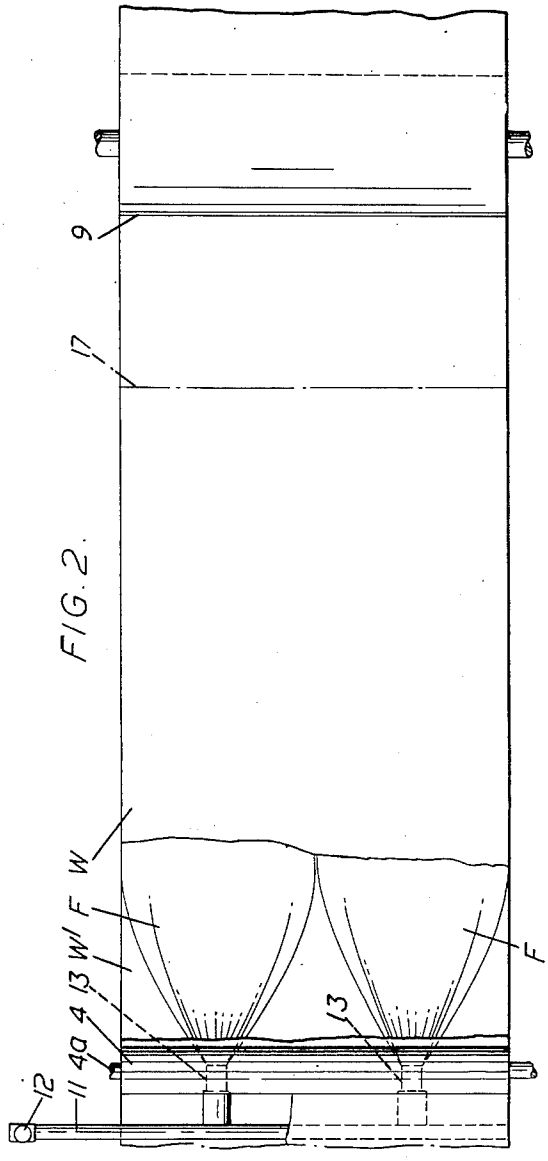


FIG. 2.

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APPARATUS FOR DRYING WEBS OF PAPER OR THE LIKE

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2 Claims. (Cl. 263—3)

This invention appertains to apparatus for drying travelling webs of relatively thin and flexible material such as paper, cloth, film, foil or the like after such webs have been operated upon by, or treated in, a process involving the deposition of moisture or certain materials upon, or the application of inks, stains, dyes or other liquids to, surfaces of the webs.

For convenience in the following further description and in the appended claims, the single term "paper" will be used in a generic sense to include relatively thin and flexible webs of any appropriate material analogous to paper.

Thus, for instance, a continuously travelling web of paper operated upon or treated as aforesaid may require to be dried prior either to re-reeling or spooling or to division into separate sheets or pieces.

Although there is no limitation in this respect, it is primarily the intention to embody the invention in an apparatus of the class suitable for drying travelling webs of paper after they have passed through a printing machine and been printed upon with a volatile ink or like medium, the purpose of the drying process in this instance being to expedite evaporation of the solvent in the medium. Such an apparatus is also suitable for the drying of films by, for instance, penetration, polymerization, oxidation and other drying processes all of which are accelerated by heat. The fusion of powders distributed on webs, as in electronographic methods of printing, is another process capable of being carried out by an apparatus of the class concerned.

The primary object of the present invention is to provide, in a web-drying apparatus, an improved relative arrangement of web guiding means and web heating means so designed as to dry travelling webs of paper more expeditiously, and hence economically, and also more efficiently, than heretofore.

The apparatus constituting this invention includes, in combination, means adapted so to guide two travelling webs of paper through a drying zone that the webs have runs with a space between them, and means arranged to supply between the said spaced runs heat which plays on the opposed surfaces of, and is trapped between, the webs.

Conveniently, the said web guiding means may be so disposed as to be adapted to guide through the drying zone two webs having straight runs which extend a short distance only apart with a clear space between them.

Although the means for supplying heat between the webs may be of any suitable character and even comprise, for instance, electric heaters, it is primarily the intention to provide, within or adjacent to the drying zone, burner means communicating with a supply of combustible fuel and so formed and disposed as to be adapted, when lighted, to direct a jet or jets of naked flame into the space between the two webs.

Thus, the idea is that the heat, e.g. naked flame, shall play between the opposed surfaces of the spaced straight runs of the travelling webs, the heat or flame being thereby enclosed and trapped by the paper. In this way greater efficiency in drying is achieved by virtue of the fact that the heat or flame is contained by the webs of paper and prevented from being diverted from its most effective position by stray draughts of air. An additional

and important advantage of the improved arrangement is, of course, that two webs are simultaneously dried, thereby expediting the drying process.

The burners, when provided, may each be of a form designed to produce, by admixture therein of combustible fluid fuel, e.g. coal gas, with air at atmospheric pressure, an only moderately hot, in contradistinction to a high temperature, flame which issues lazily from the burner suchwise as to be carried along, and to flow together, with the travelling material to be dried. The form of each of the burners may additionally be such as to produce a flame of known fan shape akin to that of a bat's wing, i.e. a laterally spread, flat flame which is very wide in relation to its thickness.

The adoption of the present invention is manifestly advantageous in connection with certain printing machines wherein it is customary to run on adjacent courses two webs both of which need drying. In other cases the same web needs drying twice. This latter necessity arises when one side of the web has to be printed upon and dried before the other. Such commonly occurs on web fed letterpress rotary perfecting presses. Accordingly, the expression "two travelling webs" used herein is intended to include not only two entirely separate webs, but also two spaced runs, travelling on adjacent courses, of the same web.

In order that the invention may be more clearly understood and readily carried into practical effect, a specific arrangement of the improved web-drying apparatus will now be described with reference to the accompanying purely diagrammatic drawings, wherein:

FIGURE 1 is a diagrammatic longitudinal sectional view of the apparatus showing gas burner flames directed into the space between two travelling webs of paper,

FIGURE 2 is a plan view of the same, but with the drying chamber removed, and portions of the upper web torn away to disclose more clearly the gas burners and the form of the flames issuing from the nozzles of the latter, and

FIGURES 3 and 4 are side and front views respectively of one of the gas burners employed.

Referring to FIGURES 1 and 2 it will be seen that the improved web-drying apparatus comprises a horizontally disposed box-like drying chamber **1** the interior of which constitutes a drying zone. The entrance into one end of this chamber is in the form of a rectangular aperture indicated at **2**. Similarly, the exit from the opposite end of the said chamber is in the form of a further rectangular aperture **3**. Adjacent to the entrance aperture **2**—on the outside of the relevant end of the chamber **1**—is a pair of web guiding rollers **4** and **5**. These rollers are disposed one above the other with a space between them, and they may be relatively adjustable heightwise to vary the depth of the said space. In this regard, for example, the spindles *4a* and *5a* of the rollers may, as shown in FIGURE 1, be mounted in arms **6** which are adjustable in or on the framework of the apparatus (not shown). One web W of paper travels beneath the upper entrance roller **4** and longitudinally right through the chamber **1**, whilst a second web W′ travels over the lower entrance roller **5** and similarly through the chamber, the two webs passing through the exit aperture **3** and respectively beneath and over a pair of superimposed exit rollers **7** and **8**. Associated with the rollers **7** and **8** are further rollers **9** and **10** for the guidance of the two webs. The distance apart of the two webs W and W′ at the exit aperture **3** may, if desired, also be varied by adjustment of the rollers **7** and **8**. In any event, the pairs of guide rollers **4** and **5** and **7** and **8** are so disposed as to guide through the drying chamber **1** two straight runs of the webs W and W′ which extend a comparatively

short distance only apart with a clear space S between them.

These runs may either extend parallel or substantially so to one another or they may, as shown in FIGURE 1, converge for a purpose presently to be described herein. That is to say, in the example illustrated, the webs W and W' are made to run closer together towards their exit from the drying chamber 1.

Where the webs are printed upon with ink, the rollers 7, 8, 9 and 10 may be water-cooled rollers the function of which is to cool down the webs and the printing on them to below the "sticky" temperature of the dried ink which, even when dry, is often thermoplastic. Also the paper tends to suffer if it is kept at, say, 300° C. for a longer time than it takes for it to travel through the chamber 1.

In the illustrated example, there is provided, immediately in advance of the pair of entrance rollers 4 and 5, a transversely extending fluid fuel pipe or manifold 11 which extends at right angles to the longitudinal edges of the travelling webs of paper. The pipe or manifold 11 is connected to a supply of any suitable combustible fluid fuel, e.g. coal gas, the flow of which through the said pipe or manifold may advantageously be controlled by adjustment of a valve provided at 12 (see FIGURE 2). The pipe or manifold 11 may advantageously be furnished with two or more suitably spaced burners such as 13 each in the form of a hollow jet having in its outer, mainly closed end a comparatively small outlet aperture communicating with a comparatively wide recess which has an inwardly, e.g. concave, bottom designed to achieve diffusion of the combustible fluid issuing through the said aperture and at the same time producing a wide thin flame of fan or bat's wing shape acquiring the sufficiency of air for complete combustion by free turbulence. Such wide, thin flames are depicted at F in FIGURE 2, and since the hollow burner jets extending from the common pipe or manifold 11 extend actually between the entrance rollers 4 and 5, then these flames are directed into the space S between the webs W and W' which space is accordingly filled with flame.

Although it is primarily the intention to supply burners of the form just described with coal or Town gas, there is no limitation in this respect since manifestly the burners could be supplied with any suitable fuel gas, such as methane or butane, or with liquid fuel such as oil or paraffin vapour, the fluid fuel being mixed with air at atmospheric pressure when necessary. But, especially when coal or Town gas is to be used, it is advantageous to employ aerated burners of the particular kind known as "Hypact" burners developed by the Research Laboratory of the Gas, Light and Coke Company in the United Kingdom. Such a hollow cylindrical burner indicated at 13 in FIGURES 3 and 4, is in the nature of an enlarged industrial jet fabricated throughout in metal and adapted to be connected on to the end or branch of a gas pipe. In the outer surface 13*a* of the comparatively thick mainly closed end 13*b* of the "Hypact" burner is milled a diametral concave recess 14. In the bottom of this recess, centrally between its ends, is a small rectangular outlet aperture 15 communicating with the hollow interior 16 of the cylindrical burner 13, this aperture 15 being produced by forming in the inner surface 13*c* of the aforementioned mainly closed end a diametral channel extending at right angles to the milled concave recess 14 (see FIGURE 4). By virtue of the formation described a marked degree of aeration is obtained by turbulence.

Each of the burners 13 is accordingly of such a form as to be adapted to produce by admixture therein of combustible fluid fuel with air at atmospheric pressure, an only moderately hot, in contradistinction to a high temperature, flame which issues lazily from the burner suchwise as to be carried along, and to flow together and in contact, with the travelling material to be dried.

By "an only moderately hot" flame is meant one of the average order of from 900° to 1400° C., depending on the zone considered, in contradistinction to an intensely hot flame of anything up to 2,200° C. In this regard it has to be borne in mind that a "lazy" flame comprises zones of various temperatures.

The longitudinal flow of the flames F usually in the direction of movement of, and hence in company with, the travelling webs is comparatively sluggish since there is no forced draught and blast of air through the burners directing the flames straight at the material. In other words, the flames issuing from the burners spread longitudinally as well as transversely with respect to the path of travel of the spaced webs. The travelling webs are accordingly contacted by gentle flames which have a comparatively large area in contact with the webs.

Moreover, these flames, being effective over comparatively large areas of the travelling webs and notwithstanding the fact that the temperature of the flames is only moderate, is adequate to dry, say, ink printed on paper and avoid the necessity to concentrate—repeatedly as necessary—a substantially more intense heat upon much smaller areas of the material. As a consequence, any tendency to alter the physical properties and dimensions of the paper during drying is minimised.

Large volume, low temperature flames, i.e. lazy or slack flames are advantageous for the purpose in view since they are of considerable persistence. Now such flames, when formed below a travelling web of paper freshly printed on both sides, may efficiently transfer the heat so that the whole web is uniformly warmed to a temperature of 300° C. or over in times that are available for webs travelling at speeds up to and in excess of 1000 ft. per minute. This temperature is that at which the special inks used for this drying process will dry in the times allowed but at which, in this time, the paper does not suffer. It has been found that the use of bat's wing burners results in a whole length of paper web in a drying chamber carrying flame below it for a distance of 4 to 7 ft., is effectively dried. It will be appreciated that a persistent lazy flame pressing against a web has exceptionally good opportunities of delivering a large proportion of its heat to the paper since it soon displaces the dead air film invariably carried along by such a web, and by virtue of the comparatively low relative velocity between the flame and the web the flame can make continuous intimate contact with the underside of the web as long as any flame persists. This arrangement results in the use of less gas for a given amount of drying, than previous known methods in a convenient short length of web run. Thus, with these facts in mind, it will be readily appreciated that lazy or slack flames issuing from burners such as 13 can, for the sake of efficiency, be directed into the space S between the two webs W and W' with every hope of successfully dispensing with the necessity for any flames below the lower web W', providing care is taken to ensure that the said space is entirely filled with flames. Any departure from this condition results in poorer heating of the lower web W', and it is generally necessary, of course, that both webs should be heated substantially the same amount.

In most cases it is possible to arrange Hypact or equivalent gas burners between two spaced webs at the beginning of their travel, as illustrated in the drawings, but in those cases where the webs require to be closer together (because only a small flame is required which would not fill a wider space of sufficient depth to accommodate the burners without contact) the burners may be mounted in advance and clear of the adjustable guide rollers 4 and 5 around which the webs run before travelling on their spaced courses through the drying chamber 1. A flat lazy flame or flames in this case is or are directed at the entrance into the space S between the webs and is or are drawn in between the webs to fill the space between them.

It may be mentioned here that the guide rollers 7 and 8 and 9 and 10 need not necessarily be water cooled because they are, in fact, cooled by the continuous feed of cold paper over them through which paper the flame heat has no time to penetrate.

Because each lazy flame is consumed during its travel along with and between the webs it will diminish in volume as it travels and the webs are therefore preferably made to converge as previously mentioned herein so that the space between them is for at least the major portion of its longitudinal dimension completely filled with flame, while such flame persists at all. In FIGURE 2, the transverse chain line 17 indicates the length of the flames F, this length being variable, within limits, by appropriate control of the fuel flow through the burners 13.

Obviously the spent products of combustion from the now dead flame or flames will issue from the gap between the exit rollers 7 and 8, and provision for exhaust has to be made to take these products away to atmosphere; also the similar products which escape laterally from between the webs W and W' travelling through the drying chamber 1 have, of course, to be exhausted.

One great advantage of "two web apparatus" is that the webs can travel at any inclination without altering the efficiency.

The lazy flames produced by the burners 13 are substantially non-luminous, or weakly luminous, so as just to avoid the deposition of carbon upon the opposed surfaces of the two webs being dried. The fact that each of the flames F is of a fan shape akin to that of a bat's wing reduces to a minimum the number of burners required adequately to cover the full width of the webs.

It may in appropriate cases be advisable to provide above the upper web W a row of small burners to burn off the volatile products given off from drying ink. In FIGURE 1, a pipe or manifold common to such a series of burners is indicated diagrammatically at 18.

The burners may, if desired, be movable from an operative position in which the or each jet of naked flame is freely directed into the space between the straight runs of the travelling web to an inoperative position in which the flame is directed safely away from both webs, the arrangement being designed to avoid damage to the webs in the event of their travel being interrupted.

The speed of the travelling webs is, of course, related to the intensity of the jet or jets of flame issuing from the burners.

Means may, if desired, also be provided for reducing, i.e. turning down, the flame jet or jets simultaneously with movement of the burners into their inoperative positions. Conversely, such means would be reversely operable to turn up the flame jet or jets each time the nozzle means were restored to their normal operative position.

It is preferred that both webs travel in the same direction—away from the burners. The web run for a letterpress perfecting rotary printing press cannot, however, conveniently be arranged so that the webs both run in the same direction because the web then "winds itself up" and cannot be drawn out simply to the folder and delivery, except sideways by means of a turner bar, unless the delivery or reel stand is enveloped by the web run. This is undesirable as the web run is then wastefully extended. Fortunately, in connection with such a machine the heat required to dry the second printing can be appreciably less than that required for the first printing and, this being so it is considered that the second printing run can be made the lower web through the drier, and travel the opposite way to the first run, i.e. towards the burners. This system does not result in as high an efficiency as when both webs travel in the same direction but is nevertheless thought to be practical when circumstances dictate its desirability.

I claim:

1. Apparatus for drying two substantially parallel webs of paper-like material comprising a drying chamber having opposed entrance and exit apertures, web feeding means and heat generating means, said web feeding means comprising two spaced apart rollers adjacent to and exterior of said drying chamber at said entrance aperture and two spaced apart rollers adjacent to and exterior of said drying chamber at said exit aperture, and said heat generating means comprising at least one gas burner having an axial outlet and adapted to generate a lazy flame, said burner being exterior of said drying chamber and positioned between said spaced apart rollers adjacent to said entrance aperture with said burner axis outlet in alignment with both of said apertures.

2. Apparatus as set forth in claim 1 in which said spaced apart rollers adjacent said exit aperture are closer together than said spaced apart rollers adjacent said entrance aperture.

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